

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

I hereby certify that this transmittal of the below described documents is being deposited with the United States Postal Service in an envelope bearing Express Mail Postage and an Express Mail Label No. EJ504928386US addressed to the Assistant Commissioner for Patents, Washington, D. C. 20231 on September 29, 1999 by David R. Gildea:

David R. Gildea
signature of person making deposit

Applicant(s): James M. Janky

Docket No. A865

Title: Method and Apparatus for Automatic and Autonomous Assignment of PRN Codes to a Multiplicity of Pseudolites

Box Patent Application
Assistant Commissioner for Patents
Washington, D.C. 20231

page 1 of 2

TRANSMITTAL OF PATENT APPLICATION (UNDER 37 CFR 1.53b)

APPLICATION ELEMENTS

1. ☒ Fee Transmittal Form
(Submit an original and a duplicate for fee processing)
2. ☒ Specification Total Pages: 18
(Background, Summary, Description of Drawings, Detailed Description, Claims, and Abstract)
3. ☒ Drawings (35 USC 113) Total Sheets: 3
4. Oath or Declaration (
 - a. ☒ Newly executed (original or copy)
 - b. ☐ Copy from a prior application (37 CFR 1.63d)
(for Continuation/Divisional with Box 17 completed)
 - i. ☐ DELETIONS OF INVENTOR(S) Signed statement attached deleting inventor(s) named in the prior application, see 37 CFR 1.63d2 and 1.33b.
5. ☐ Incorporation By Reference (useable if Box 4b is checked)
The entire disclosure of the prior application, from which a copy of the oath or declaration is supplied under Box 4b, is considered as being a part of the disclosure of the accompanying application and is hereby incorporated reference therein.
6. ☐ Microfiche Computer Program (Appendix)
7. ☐ Nucleotide and/or Amino Acid Sequence Submission
(if applicable, all necessary)
 - a. ☐ Computer Readable Copy
 - b. ☐ Paper Copy (identical to computer copy)
 - c. ☐ Statement verifying identity of above copies

Docket No.: A865

8. ☒ Assignment Papers (cover sheet & document(s))
(duplicate cover sheet if paid by deposit account)
9. ☐ 37 CFR 3.73b Statement (when there is an assignee)
☒ Power of Attorney
10. ☐ English Translation Document (if applicable)
11. ☐ Information Disclosure Statement (IDS)/PTO-1449
☐ Copies of IDS Citations
12. ☐ Preliminary Amendment
13. ☒ Return Receipt Postcard (MPEP 503)
(Should be specifically itemized)
14. ☐ Small Entity Statements
☐ Statement filed in prior application still proper and desired
15. ☐ Certified Copy of Priority Document(s)
(if foreign priority is claimed)
16. ☒ Other Title page for application ☒
☐ ☒
☐ ☒
☐ ☒

17. If a CONTINUING APPLICATION, check appropriate box and supply the requisite information:

☐ Continuation ☐ Divisional ☐ Continuation-in-part (CIP)
of prior application: ☒

18. Correspondence Address
☒ Correspondence Address Below

NAME David R. Gildea, Reg. No. 38,465

ADDRESS 435 Hermosa Way

CITY Menlo Park, CA 94025 STATE California ZIP CODE 94025

COUNTRY U.S.A. TELEPHONE 650-853-0189 FAX 650-324-9111

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

First Named Applicant: James M. Janky

Title: Method and Apparatus for Automatic and Autonomous Assignment of PRN

Codes to a Multiplicity of Pseudolites

FEE TRANSMITTAL FORM


	NUMBER OF CLAIMS	EXTRA CLAIMS	RATE	FEEs
Basic Application Fee				\$760
Total Claims	18	-20	0	\$18
Independent Claims	2	-3	0	\$78
If multiple dependent claims are presented, add			\$260	\$0
Subtotal of above calculations				\$760
Reduction by 50% for Small Entity				\$0
Subtotal				\$760
Add Assignment Recording Fee			\$40	\$40
Total				\$800

The United States Patent Office is hereby authorized to deduct the amount of the total from deposit account number 500604. The name and address of the depositor are:

Trimble Navigation Limited
645 North Mary Avenue
Sunnyvale, California 94086

A duplicate copy of this fee transmittal letter is enclosed.

Date: September 29, 1999


David R. Gildea
Reg. No. 38,465

UNITED STATES PATENT APPLICATION
FOR

Method and Apparatus for Automatic and Autonomous Assignment of
PRN Codes to a Multiplicity of Pseudolites

Invented by
James M. Janky

Prepared by
David R. Gildea
Gildea Patent Agency
Reg. No. 38,465

**Method and Apparatus for Automatic and Autonomous Assignment
of PRN Codes to a Multiplicity of Pseudolites**

5

BACKGROUND OF THE INVENTION

Field of the Invention

10 The invention relates generally to pseudolites for
satellite positioning systems and more particularly to a
pseudolite for transmitting a positioning system signal
having identification information corresponding to a
positioning system satellite that is currently out-of-view.

15 Description of the Prior Art

20 The global positioning system (GPS) operated by the
United States government uses microwave transmissions from
orbiting satellites with known orbits. These transmissions
are received by a satellite navigation receiver for
determining the location of the receiver. Such microwave
frequencies are blocked by the earth or by local
obstructions such as buildings. Locating the receiver in an
urban city block or inside a building can severely limit
25 performance by excluding necessary satellites from a
constellation being tracked.

Each of the GPS satellites transmits a GPS signal on
the same carrier frequency modulated by location-
30 determination information from that GPS satellite and spread
by pseudorandom (PRN) codes that are distinct for that GPS
satellite. Two different PRN codes are used by each
satellite: a long code termed the precise/encrypted (P/Y)
code and a short code of 1023 bits or chips termed the
35 coarse/acquisition (C/A) code. Either the P/Y code or the
C/A code identifies the GPS satellite transmitting the GPS

signal and enables a GPS navigation receiver to distinguish the GPS signal from one GPS satellite from the GPS signal from another GPS satellite. The P/Y code is encrypted and restricted for use to those authorized by the United States Department of Defense while knowledge of the C/A code is available to all users.

There are over one thousand distinct C/A PRN codes that could be used for identification for distinguishing the GPS satellites. Of these C/A PRN codes, the United States government has currently allocated about thirty-two for use by GPS satellites. Existing GPS receivers are designed to search for GPS signals from GPS satellites having any one of these codes. Of these thirty-two allocated satellites, currently about twenty-seven are orbiting and operational and five are not operational. Typically, of the orbiting operational satellites, in mid-latitudes about one-third will be above the Earth horizon and potentially receivable by a GPS receiver and about two-thirds will be unreceivable to the receiver by being below the horizon. Therefore, about twenty-three of the satellites will not be receivable for use by the GPS receiver.

Existing GPS applications use pseudolites to augment the satellite constellation and thus improve availability of the GPS signal. Such pseudolites mimic the satellite transmissions by broadcasting pseudo GPS signals, but are fixed on the ground and transmit the location-determination information appropriate to the geographical location of the pseudolite. The pseudolites make use of PRN codes that have not been allocated for GPS satellites. Signal reception is nearly guaranteed when the pseudolite is located nearby due to relatively higher signal strength of the received pseudo GPS signal. In addition to the thirty-two PRN codes allocated for GPS satellites the United States government currently allocates about four codes for the use of

pseudolites. For example, a pair of pseudolites at the end of an airport's runway are conventionally used to enhance the position determination of a navigational receiver in a landing aircraft. It has been proposed that several
5 pseudolites be used in a metropolitan area in order to improve GPS service in urban canyons and inside of buildings.

Fast GPS signal acquisition is important in
10 applications for many GPS navigation receivers. For example, a battery powered receiver alternating between operational and standby modes needs a fast acquisition in order to have good battery life with small batteries. One technique for achieving a fast acquisition is to minimize
15 the number of PRN codes or other types of identifications that are searched in order to acquire GPS signals. However, a requirement for more than four pseudolites increases the number PRN codes that must be stored or generated in a GPS receiver, thereby slowing signal acquisition time in certain
20 circumstances.

There is a need for a pseudolite using a PRN code identification that minimizes the number of PRN codes that must be stored for search in a GPS receiver. Further, there
25 is a need for an autonomous assignment procedure that simplifies and automates the choosing process, especially when there are a multiplicity of pseudolites to be installed, and the pseudolites could be supplied by different manufacturers.

30

SUMMARY OF THE INVENTION

It is therefore an object of the present invention to provide a positioning system (PS) pseudolite for a satellite positioning system where the PS pseudolite transmits a pseudo PS signal using a PS satellite identification for a PS satellite that is allocated for the positioning system but is currently unreceivable in the vicinity of the PS pseudolite.

The PS pseudolite of the present invention operates autonomously and independently from any central authority for determining which particular one of the unreceivable PS satellite identifications is used for transmitting a pseudo PS signal.

Briefly, in a preferred embodiment, a positioning system (PS) pseudolite of the present invention is a global positioning system (GPS) pseudolite. The GPS pseudolite mimics a global positioning system (GPS) signal by using a C/A pseudorandom (PRN) identification code for a GPS satellite that is allocated in the GPS system but is unreceivable in the local vicinity because it is below the local horizon in its orbit. The pseudolite transmits location-determination information including ephemeris data corresponding to the geographical location of the pseudolite. In order to ensure that two of the GPS pseudolites in the same vicinity do not use the identification PRN code from the same unreceivable GPS satellite, each GPS pseudolite listens first before transmitting to detect the identifications in the received GPS signals and uses PRN codes that are not being received. This autonomous code assignment process is independent of any central authority so that multiple vendors can supply pseudolites even in the same local area.

The GPS pseudolite includes a satellite availability calculator including a visibility calculator and an operational identifier. The visibility calculator uses GPS satellite almanac and/or ephemeris orbital parameter data for determining the GPS satellites that are in-view having a line-of-sight to the GPS pseudolite and the GPS satellites that are out-of-view, for example behind the Earth. The operational identifier determines the GPS satellites that are operational and those that are non-operational. Non-operational GPS satellites include those GPS satellites that have not been launched or have been turned off. The GPS satellites that are both operational and in-view are designated as receivable GPS satellites. The GPS satellites that are either out-of-view or non-operational are designated as unreceivable GPS satellites. The GPS pseudolite further includes a GPS receiver, a pseudolite detector, a satellite identification selector, and a pseudolite GPS transmitter. The GPS receiver receives GPS signals from the receivable GPS satellites and pseudo GPS signals from other GPS pseudolites in the vicinity and passes the received identifications to the pseudolite detector. The pseudolite detector detects that another GPS pseudolite in the vicinity is transmitting when a received identification matches the identification of an unreceivable GPS satellite. The satellite identification selector selects an available identification that both corresponds to one of the unreceivable GPS satellites and is not currently being used by another GPS pseudolite. The pseudolite transmitter then transmits a pseudo GPS signal having the selected available PRN code identification.

An advantage of the PS pseudolite of the present invention for a positioning system is that the PS pseudolite re-uses identifications that have been allocated for positioning system satellites, thus reducing the search time

for a remote GPS receiver to acquire a pseudolite transmission.

Another advantage of the PS pseudolite of the present invention is that no coordination is needed by either manufacturers or system integrators with regard to selection of unique and independent identifications.

These and other objects and advantages of the present invention will no doubt become obvious to those of ordinary skill in the art after having read the following detailed description of the preferred embodiments which are illustrated in the various figures.

15

BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 illustrates a global positioning system (GPS) having a GPS pseudolite of the present invention;

5

Fig. 2 is a block diagram of the GPS pseudolite of the global positioning system of Fig. 1; and

Fig. 3 is a table of allocated GPS satellites for the
10 global positioning system of Fig. 1.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

Fig. 1 illustrates an autonomous code assignment pseudolite system of the present invention referred to by the general reference number 10. The system 10 includes a global positioning system (GPS) navigation receiver 12 on or near the Earth 14 for receiving GPS signals from in-view GPS satellites 16 having a line-of-sight to the receiver 12 and pseudo GPS signals from one or more nearby GPS pseudolites 20 of the present invention. The GPS navigation receiver 12 uses the GPS signals and pseudo GPS signals for determining its geographical location and time. Although only one GPS navigation receiver 12 is shown in Fig. 1, it is envisioned that the system 10 may include several GPS navigation receivers 12. Of course, the GPS navigation receivers 12 may be used for application that are not strictly navigation, such as surveying, mapping, event tagging, and the like where location, velocity and/or time is required.

Out-of-view GPS satellites 24 not having a line-of-sight to the GPS navigation receiver 12 are typically not receivable by the receiver 12 because their GPS signals are blocked by the Earth 14. The in-view GPS satellites 16 orbit the Earth 14 in a period of approximately twelve hours so that each of the in-view GPS satellites 16 periodically sets below the horizon of the Earth 14 and becomes an out-of-view GPS satellite 24, then rises to become an in-view GPS satellite 16, and so on. Similarly, each of the out-of-view GPS satellites 24 periodically rises above the horizon of the Earth 14 and becomes an in-view GPS satellite 16, then sets to become an out-of-view GPS satellite 24, and so on.

The GPS signal is formatted according to GPS specifications for carrying satellite identification information and location-determination information. A

written source of such GPS specifications is available from
ARINC Research Corporation of El Segundo, California under
the title of "GPS Interface Control Document ICD-GPS-200,
NAVSTAR GPS Space Segment and Navigation User Interfaces"
5 revised in 25 September 1997.

Briefly, the GPS signal has an L-band carrier signal
modulated by GPS data bits of twenty milliseconds that are
spread by a pseudorandom (PRN) code that repeats every one
10 millisecond. The GPS data bits and the PRN codes of all the
GPS signals are synchronized to transmit at the same times
beginning with 00 hours, 00 minutes, 00.000 seconds of each
GPS week and continuing throughout the week. The PRN code
in each GPS signal is distinct, thereby allowing a GPS
15 receiver to use the PRN code as identification information
for distinguishing the GPS signal from one GPS signal source
from the GPS signal from another GPS signal source. The
United States government has allocated about thirty-two of
these PRN codes for current use in the global positioning
20 system. However, about five GPS satellites are currently
non-operational, and therefore, unreceivable because they
have not been launched or have been decommissioned. The
particular PRN codes that are operational varies over time
as old GPS satellites are retired and new ones are launched.

25 The GPS data bits carry location-determination
information segmented into 1500 bit frames, also called
pages, of thirty seconds. The frames are segmented into
five 300 bit subframes of six seconds each. The subframes
30 are segmented into thirty 10 bit words. Each subframe
begins with a known preamble and includes a Z-count. The Z-
count gives GPS-based time-of-transmission for the preamble.
Subframes two and three the GPS signal from the GPS
satellites 16, 24 and the GPS pseudolite 20 includes
35 ephemeris data for the GPS satellite 16, 24 or the GPS

pseudolite 20 transmitting that GPS signal. The ephemeris data is highly accurate and is updated about hourly.

The ephemeris data for the GPS satellites 16, 24 describes the current orbital parameters for the motion of the GPS satellites 16, 24 through space. The GPS navigation receiver 12 uses the ephemeris data along with the GPS based-time for determining the time-variable locations-in-space for the in-view GPS satellites 16 whose GPS signals are received and processed. The ephemeris data for the GPS pseudolite 20 uses the same format for describing a ground-fixed location of the GPS pseudolite 20 that has been determined with a survey. In a preferred embodiment, the GPS navigation receiver 12 determines the fixed location of the GPS pseudolite 20 in a similar way as for the locations-in-space of the in-view GPS satellites 16. Alternatively, because the ephemeris data describes a fixed location, the GPS navigation receiver 12 can determine the location of the GPS pseudolite 20 without first determining a GPS-based time. With the four or more of the locations-in-space for the in-view GPS satellites 16 and/or the locations of the GPS pseudolites 20, the GPS navigation receiver 12 can determine its own geographical location. Fewer than four in-view GPS satellites 16 and/or GPS pseudolites 20 are required when other navigation information such as an accurate time, inertial information, map matching, or altitude is available. More than four in-view GPS satellites 16 and/or GPS pseudolites 20 are useful for improving the accuracy of the location.

Although the preferred embodiment is described in terms of the global positioning system the elements and methods of the present invention are applicable to other satellite positioning systems such as the global orbiting navigational system (GLONASS). GLONASS satellites transmit GLONASS signals having the same pseudorandom code that are

identified by distinct carrier frequencies. A comparable GLONASS pseudolite system would use transmission frequencies based on those used by out-of-view or non-operation GLONASS satellites.

5

Fig. 2 is a block diagram of the pseudolite of the present invention referred to by the general reference number 20. The pseudolite 20 includes a pseudolite GPS receiver 42, a processor 44, a memory 46, a pseudolite GPS transmitter 48, and an interface 52. The GPS receiver 42 receives GPS signals from the in-view GPS satellites 16 (Fig. 1) and the other GPS pseudolites 20 (Fig. 1) and passes information to the processor 44 for GPS-based time, the GPS satellite almanac and/or ephemeris orbital parameters, and the identifications of the satellite and pseudo GPS signals that are being received. In general, the identifications include the identifications corresponding to the in-view GPS satellites 16 transmitted by the in-view GPS satellites 16, and the identifications for the out-of-view GPS satellites 24 and non-operational GPS satellites (Fig. 3) transmitted by the other pseudolites 20. The processor 44 operates in a conventional manner for reading and writing data into the memory 46 and executing program codes in the memory 46 for receiving information and controlling the elements of the GPS pseudolite 20 including the GPS receiver 42, the pseudolite transmitter 48, and the interface 52. Preferably, the stored data in the memory 46 includes information for a fixed ground-based geographical location of the GPS pseudolite 20. Alternatively, the GPS receiver 42 may be a survey grade GPS receiver equipped for real time operation for providing and updating a precise geographical location for the pseudolite 20.

The memory 46 includes program codes for a satellite availability calculator 62, a pseudolite detector 64, and a satellite identification selector 66. The satellite

availability calculator 62 includes a visibility calculator 74 and an operational identifier 76. The visibility calculator 74 uses the GPS satellite almanac or ephemeris orbital parameters for determining the in-view GPS satellites 16 having a line-of-sight to the GPS pseudolite 20 and the out-of-view GPS satellites 24 where the line-of-sight is blocked by the Earth 14 (Fig. 1). The visibility calculator 74 can be programmed with the coordinates and heights of local obstructions such as the walls of an open mine, a building, or a mountain range for differentiating in-view GPS satellites 16 from out-of-view GPS satellites 24.

The operational identifier 76 uses the satellite orbital parameters and optionally uses information received through the interface 52 that is provided by the United States government for determining the identifications for the orbiting operational GPS satellites 16, 24 and the non-operational GPS satellites (Fig. 3). The satellite availability calculator 62 designates the in-view GPS satellites 16 that are operational as receivable GPS satellites. The out-of-view GPS satellites 24 and the non-operational GPS satellites (Fig. 3) are designated as unreceivable GPS satellites. The pseudolite detector 64 detects another GPS pseudolite 20 in the vicinity when a received identification matches the identification of an unreceivable GPS satellite. The satellite identification selector 66 selects an available identification that both corresponds to one of the unreceivable GPS satellites and is not currently being used by another one of the GPS pseudolites 20. Preferably, the visibility calculator 74 calculates information for which of the out-of-view GPS satellites 24 have the longest time periods before they become in-view GPS satellites 16 and provides this information to the satellite identification selector 66. The satellite identification selector 66 then selects the

identification for the out-of-view GPS satellite 24 having the longest time period that is available. The pseudolite GPS transmitter 48 then transmits a pseudo GPS signal having the selected available PRN code identification and location-determination information for the geographical location of the present GPS pseudolite 20. The GPS navigation receiver 20 determines a geographical location from the GPS signals and the pseudo GPS signals from the in-view GPS satellites 16 and the pseudolites 20, respectively. This method reduces the number of PRN codes that must be searched in the GPS receiver 12 to acquire a new pseudolite.

Fig. 3 is a table showing the PRN numbers 1-32 and the associated orbital slots of the allocated GPS satellites for the global positioning system as of September 29, 1999. The alpha identification character of the slot, A through F, represents the six orbits for the GPS satellites 16, 24. The numeric identification character of the slot, 1 through 5, represents the five positions within the orbit. As of September 29, 1999, PRN codes 11, 12, 20, 28, and 32 are non-operational. A current status of the operational GPS satellites is available from the United States government on-line at www.navcen.uscg.mil.

Although the present invention has been described in terms of the presently preferred embodiments, it is to be understood that such disclosure is not to be interpreted as limiting. Various alterations and modifications will no doubt become apparent to those skilled in the art after having read the above disclosure. Accordingly, it is intended that the appended claims be interpreted as covering all alterations and modifications as fall within the true spirit and scope of the invention.

What is claimed is:

IN THE CLAIMS

1. A pseudolite for a positioning system (PS), said positioning system having several orbiting PS satellites transmitting respective PS signals, each one of said PS signals having an identification for a one of said PS satellites transmitting said one of said PS signals and location-determination information corresponding to a location-in-space for said one of said PS satellites transmitting said one of said PS signals, the pseudolite comprising:

an availability calculator for determining unreceivable ones of said PS satellites;

an identification selector coupled to the availability calculator for selecting a particular one of said identifications corresponding to a particular one of said unreceivable PS satellites; and

a transmitter coupled to the PS satellite selector for transmitting a pseudo PS signal having said particular identification and location-determination information corresponding to a geographical location of the pseudolite.

2. The pseudolite of claim 1, wherein:

the availability calculator includes a visibility calculator for determining out-of-view ones of said PS satellites and designating said out-of-view PS satellites as said unreceivable PS satellites.

3. The pseudolite of claim 2, wherein:

said visibility calculator is for determining said out-of-view PS satellites based upon PS satellite orbital parameter information and time.

4. The pseudolite of claim 2, wherein:

said visibility calculator is for determining said out-of-view PS satellites based upon location information and height of a local obstruction.

5 5. The pseudolite of claim 1, wherein:

the availability calculator includes an operational identifier for determining non-operational ones of said PS satellites and designating said non-operational PS satellites as said unreceivable PS satellites.

10

6. The pseudolite of claim 1, wherein:

said PS satellites include GPS satellites for transmitting GPS signals as said PS signals having said identification in a form of a distinguishable pseudorandom spreading code.

15

7. The pseudolite of claim 1, wherein:

said PS satellites include global orbiting navigation system (GLONASS) satellites for transmitting GLONASS signals as said PS signals having said identification in a form of a distinguishable carrier frequency.

20

8. The pseudolite of claim 1, further comprising:

25

a pseudolite PS receiver for receiving signal energy for received ones of said PS signals having corresponding received ones of said identifications; and

a pseudolite detector for preventing the identification selector from selecting any one of said received identifications as said particular identification.

30

9. The pseudolite of claim 1, wherein:

said pseudo PS signal is for reception by a PS navigation receiver for determining at least one of (i) location and (ii) time.

35

10. A method in a pseudolite for a positioning system (PS),
said positioning system having several orbiting PS
satellites transmitting respective PS signals, each one of
said PS signals having an identification for a one of said
5 PS satellites transmitting said one of said PS signals and
location-determination information corresponding to a
location-in-space for said one of said PS satellites
transmitting said one of said PS signals, the method
comprising steps of:

10 determining unreceivable ones of said PS
satellites;

selecting a particular one of said identifications
corresponding to a particular one of said unreceivable PS
satellites; and

15 transmitting a pseudo PS signal having said
particular identification and location-determination
information corresponding to a geographical location of the
pseudolite.

20 11. The method of claim 10, wherein:

the step of determining said unreceivable PS
satellites includes steps of: determining out-of-view ones
of said PS satellites; and designating said out-of-view PS
satellites as said unreceivable PS satellites.

25 12. The method of claim 11, wherein:

the step of determining said out-of-view PS
satellites includes determining said out-of-view PS
satellites based upon PS satellite orbital parameter
30 information and time.

13. The method of claim 11, wherein:

the step of determining said out-of-view PS
satellites determining said out-of-view PS satellites based
35 upon location and height of a local obstruction.

14. The method of claim 10, wherein:

the step of determining said unreceivable PS satellites includes steps of: determining non-operational ones of said PS satellites; and designating said non-operational PS satellites as said unreceivable PS satellites.

15. The method of claim 10, wherein:

said PS satellites include GPS satellites for transmitting GPS signals as said PS signals having said identification in a form of a distinguishable pseudorandom spreading code.

16. The method of claim 10, wherein:

said PS satellites include global orbiting navigation system (GLONASS) satellites for transmitting GLONASS signals as said PS signals having said identification in a form of a distinguishable carrier frequency.

17. The method of claim 10, further comprising steps of:

receiving signal energy for received ones of said PS signals having corresponding received ones of said identifications; and

the step of selecting particular identification includes selecting said particular identification not corresponding to any one of said received identifications.

18. The method of claim 10, wherein:

said pseudo PS signal is for reception by a PS navigation receiver for determining at least one of (i) location and (ii) time.

ABSTRACT OF THE DISCLOSURE

A pseudolite for transmitting a global positioning system (GPS) signal having identification information for a GPS satellite that is currently out-of-view. The pseudolite mimics a global positioning system (GPS) signal by using a C/A pseudorandom (PRN) identification code for a GPS satellite that is allocated in the GPS system but is unreceivable in the local vicinity and location-determination information including ephemeris data corresponding to the geographical location of the pseudolite. In order to ensure that two of the GPS pseudolites in the same vicinity do not use the identification PRN code from the same out-of-view GPS satellite, the pseudolite listens first before transmitting to detect the identifications in the received GPS signals.

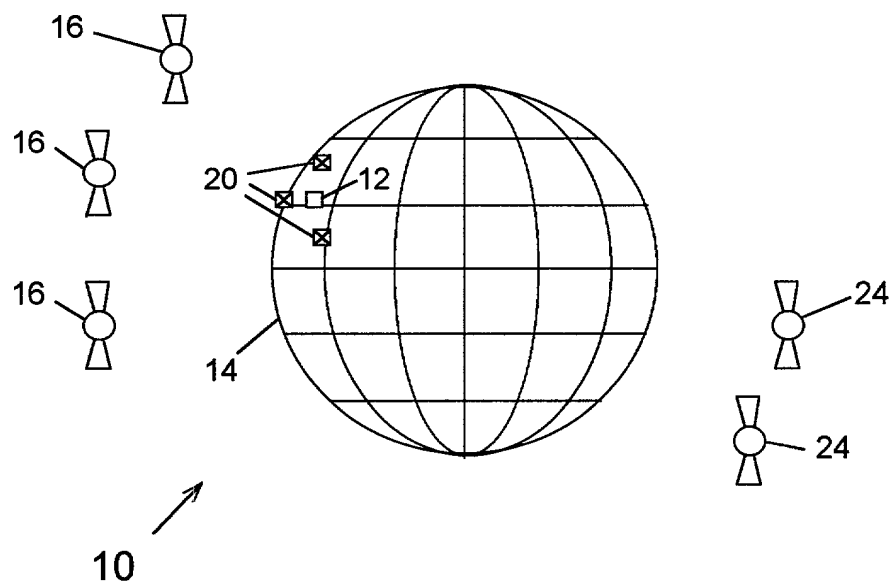


Fig. 1

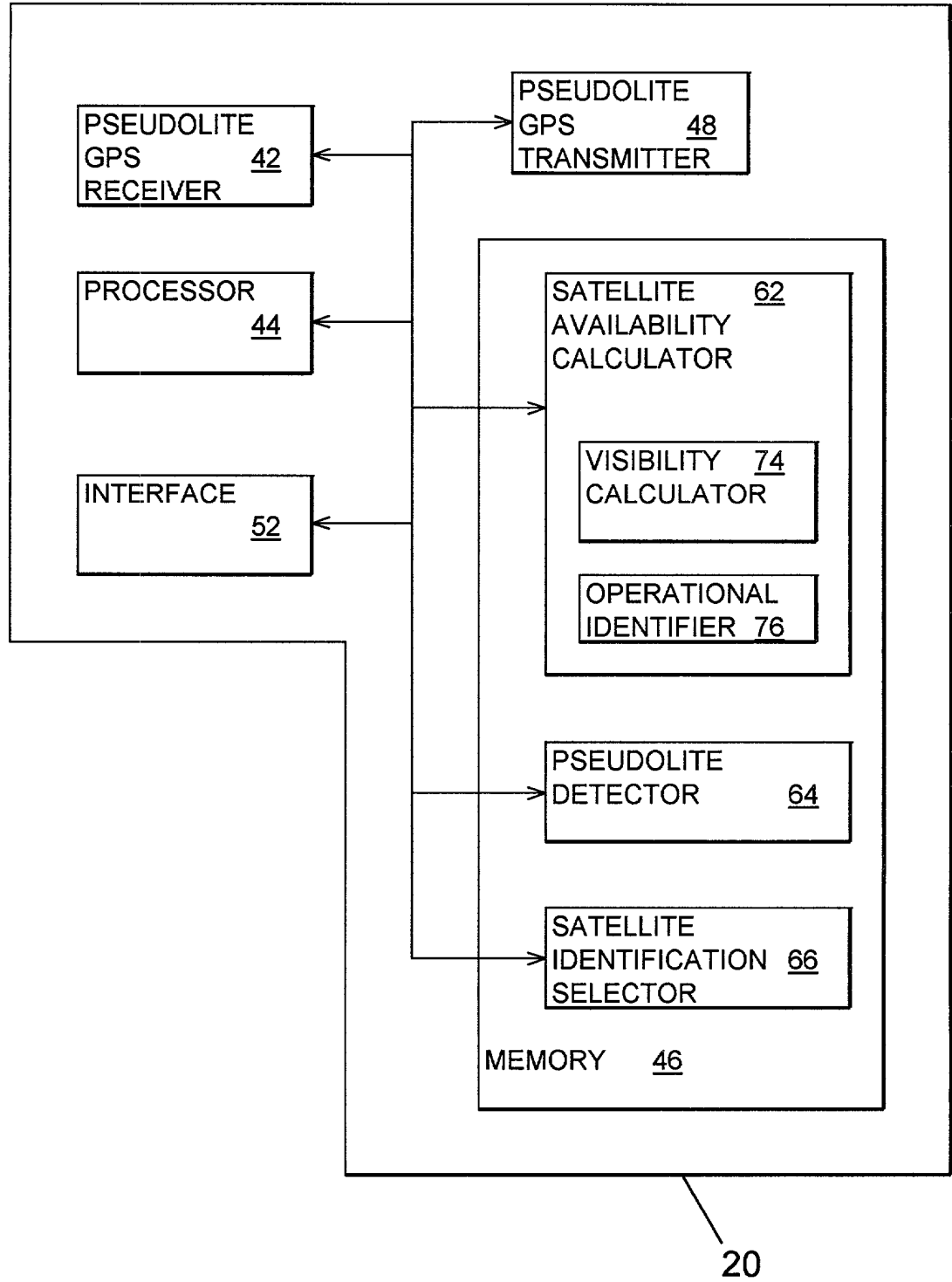


Fig. 2

PRN NO.	SLOT	PRN NO.	SLOT
1	F1	17	D3
2	B3	18	F3
3	C2	19	A4
4	D4	20	NON-OPERATIONAL
5	B4	21	E2
6	C1	22	B1
7	C4	23	E4
8	A5	24	D1
9	A1	25	A2
10	E3	26	F2
11	NON-OPERATIONAL	27	A3
12	NON-OPERATIONAL	28	NON-OPERATIONAL
13	F5	29	F4
14	E1	30	B2
15	D2	31	C3
16	E5	32	NON-OPERATIONAL

Fig. 3

DECLARATION FOR PATENT APPLICATION

page 1 of 2

As a below named inventor, I hereby declare that my residence, post office address and citizenship are as stated below my name and that I believe that I am the original, first and sole inventor (if only one inventor is listed below) or an original, first and joint inventor (if plural names are listed below) of the subject matter which is claimed and for which a patent is sought on the invention entitled: Method and Apparatus for Automatic and Autonomous Assignment of PRN Codes to a Multiplicity of Pseudolites, the specification of which (check one)

☒ is attached hereto or
_____ was filed on * * * as Application Serial No. * * * and
was amended on _____ (if applicable).

I hereby state that I have reviewed and I understand the contents of the above-identified specification, including the claims, as amended by any amendments referred to above.

I acknowledge the duty to disclose information which is material to the examination of this application in accordance with Title 37, Code of Federal Regulations, Section 1.56(a).

I hereby claim foreign priority benefits under Title 35, United States Code, Section 119 of any foreign application(s) for patent or inventor's certificate listed below and have also identified below any foreign application for patent or inventor's certificate have a filing data before that of the application on which priority is claimed:

Prior Foreign Application(s)

Priority Claimed

_____	_____	_____
(Number)	(Country)	(Day/Month/Year Filed)
_____	_____	_____
(Number)	(Country)	(Day/Month/Year Filed)

___ Yes ___ No

___ Yes ___ No

I hereby claim benefit under Title 35, United States Code, Section 120 of any United States application(s) listed below and, insofar as the subject matter of each of the claims of this application is not disclosed in the prior United States application in the manner provided by the first paragraph of Title 35, United States Code, Section 112, I acknowledge the duty to disclose material information as defined in Title 37, Code of Federal Regulation, 1.56(a) which occurred between the filing date of the prior application and the national or PCT international filing data of this application:

_____	_____
(Application Serial No.)	(Filing Date)

Status: ___ Patented
___ Pending
___ Abandoned

_____	_____
(Application Serial No.)	(Filing Date)

Status: ___ Patented
___ Pending
___ Abandoned

DECLARATION FOR PATENT APPLICATION

page 2 of 2

I hereby declare that all statements made herein of my own knowledge are true, that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

Name of Inventor: James M. Janky

Signature of Inventor: _____

James M. Janky

Date: _____

9-27-99

Residence: Los Altos, California

Citizen of: United States of America

Post Office Address: 894 Lockhaven Drive, Los Altos, California 94024

POWER OF ATTORNEY BY ASSIGNEE

The undersigned, as Assignee of the entire right, title, and interest in and to the subject matter which is described and claimed and for which a patent is sought on the invention entitled: Method and Apparatus for Automatic and Autonomous Assignment of PRN Codes to a Multiplicity of Pseudolites

the specification of which

 x is attached hereto;
 was filed on * * * as Application Serial No. * * *
and was amended on (if applicable);

Assignment recorded on at Reel/Frame
(if applicable)

hereby elects to control the prosecution of this application and hereby appoints the following attorney(s) and/or agent(s) to prosecute this application and transact all business in the Patent and Trademark Office in connection therewith:

David R. Gildea

Reg. No. 38,465

Address all correspondence to: **David R. Gildea**
435 Hermosa Way
Menlo Park, CA 94025

Address all telephone calls to **David R. Gildea** at telephone no. **650-853-0189** or facsimile no. **650-324-9111**.

Assignee hereby petitions and requests that this file be closed to the inventor(s), or representative(s) thereof.

Trimble Navigation Limited

Dated: 9-27-99

by James M. Janby

title: Vice President Intellectual Property

Trimble Navigation Limited
645 North Mary Avenue, Sunnyvale, California 94086